



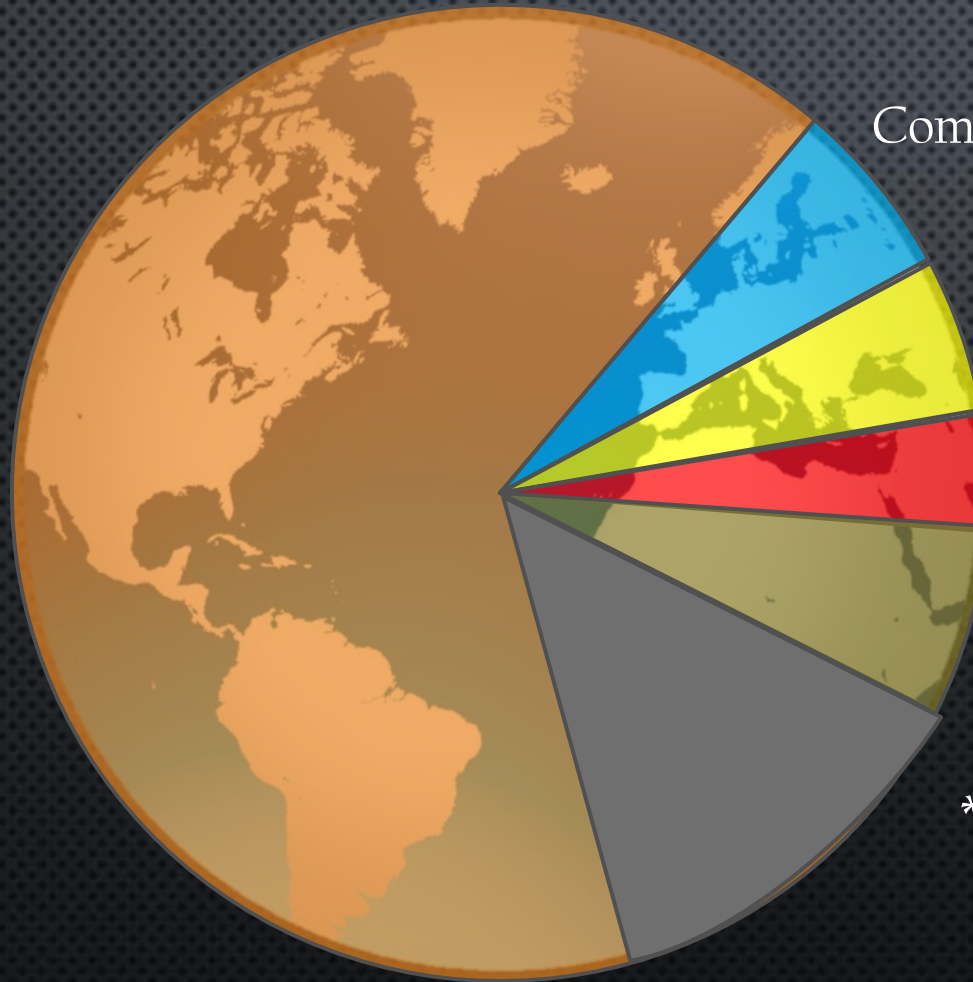
# EMERGING TECHNOLOGIES IN BUSINESS AND GENERAL AVIATION



# GLOBAL CIVIL TYPE CERTIFICATE AIRCRAFT POPULATION ≈ 334,000



Piston Planes ≈  
265,000  
2018: +5.0%



Commercial Airliners ≈ 19,000



Business Jets ≈ 17,000  
2018: +3.8%



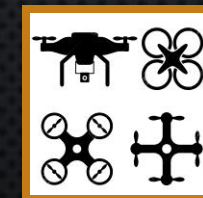
Turboprops ≈ 12,500  
2018: +5.2%



Rotorcraft ≈ 20,500  
2018: +5.4%



\*Registered UAS ≈  
1,200,000





# GLOBAL GENERAL AVIATION DISTRIBUTION

A grayscale world map is centered on the Atlantic Ocean, showing the outlines of the continents. Overlaid on the map are six semi-transparent gray rectangular boxes, each containing text indicating the percentage of global general aviation for a specific region. The regions and their percentages are: North America (60%), Europe (26%), Asia (2%), Africa (3%), South America (5%), and Oceania (4%).

North America = 60%

Europe = 26%

Asia = 2%

Africa = 3%

South America = 5%

Oceania = 4%



# DISRUPTIVE CHANGE



**Easter morning 1900: 5<sup>th</sup> Ave, New York City. Spot the automobile.**



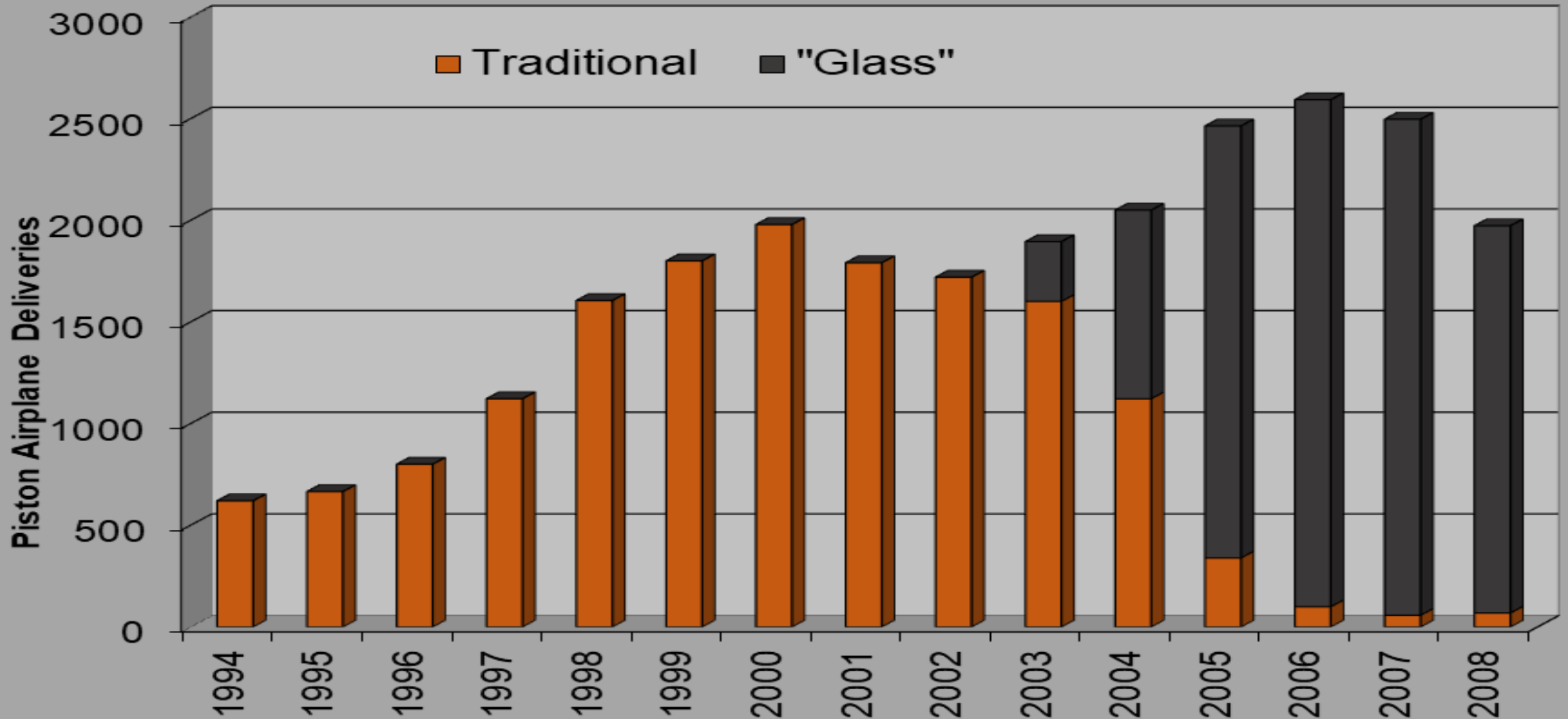
Source: US National Archives.

**Easter morning 1913: 5<sup>th</sup> Ave, New York City. Spot the horse.**



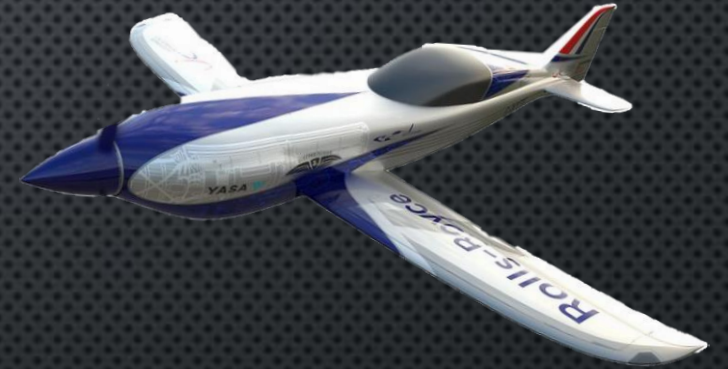
Source: George Grantham Bain Collection.

# DISRUPTIVE CHANGE IN GENERAL AVIATION





# HYBRID & ELECTRIC CONVENTIONAL STRUCTURE AIRCRAFT





# MODIFIED LEGACY AIRCRAFT

## MAGNI-X BEAVER ON FLOATS – HARBOUR AIR





# MODIFIED LEGACY AIRCRAFT

## ZEROAVIA



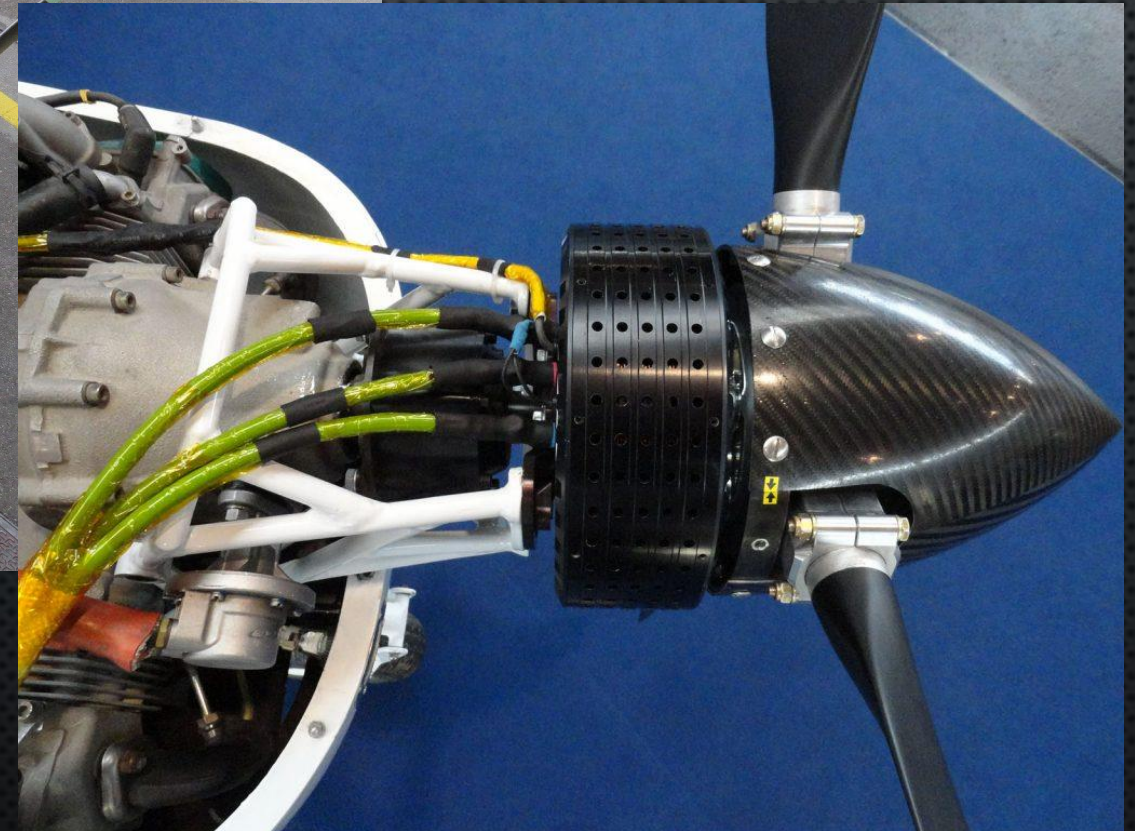
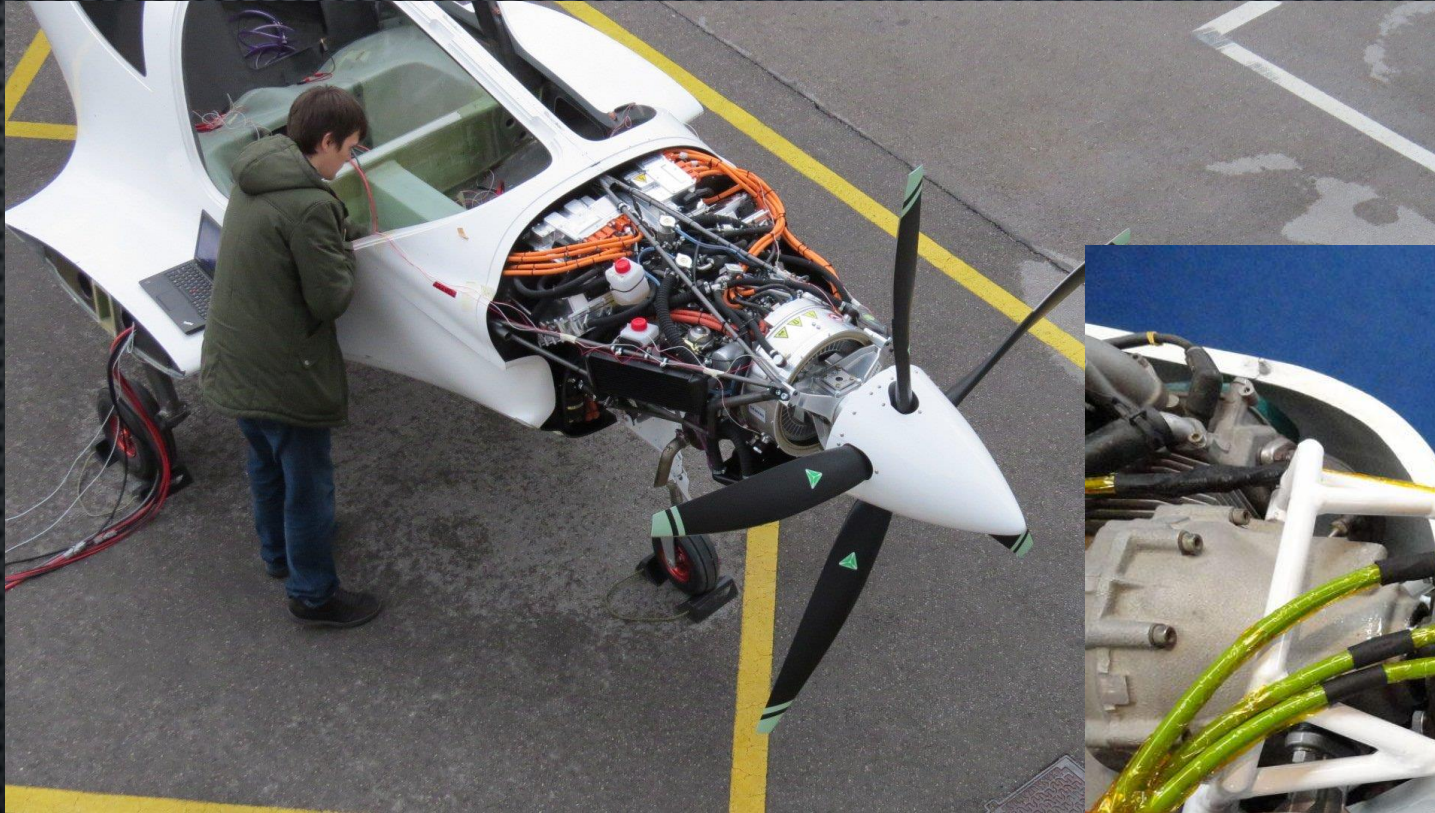
Hydrogen Fuel-cell Powertrain





# MODIFIED LEGACY AIRCRAFT

## HYBRID ELECTRIC PANTHERA



There is a Rotax 912 combined with an electric motor on the prop shaft



# MODIFIED LEGACY AIRCRAFT

## AMPAIRE



We are transforming existing passenger planes to electric. Our first twin-engine plane has a combustion engine in the nose and an electric engine in the tail, providing redundancy and improved levels of safety.



# NEW CLEAN SHEET CONVENTIONAL STRUCTURE



## PIPISTREL ALPHA ELECTRO



- Conventional airplane with electric engine
- Certified in EU
- Trying to get approval for training in CA

## BYE AEROSPACE eFLYER



- Conventional airplane w/ electric engine
- Flying Siemens production ready engine/controller in existing LSA airframe
- Picture of airframe in development
- Deposits coming in from flight schools



# BYE AEROSPACE eFLYER





# NASA X-57 DISTRIBUTED ELECTRIC PROPULSION DEMONSTRATOR



- Wingtip engines provide propulsion
- LE engines provide high lift
- Pilot has no direct control of propulsion system



# DAHER, AIRBUS, SAFRAN - ECO-PULSE





# SVO EQUIPPED AIRPLANE

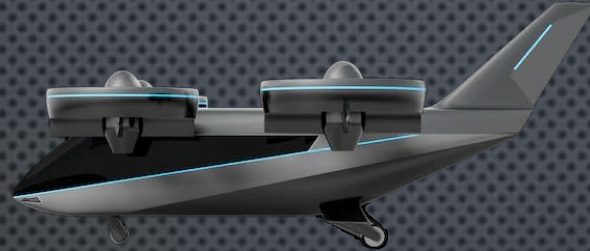
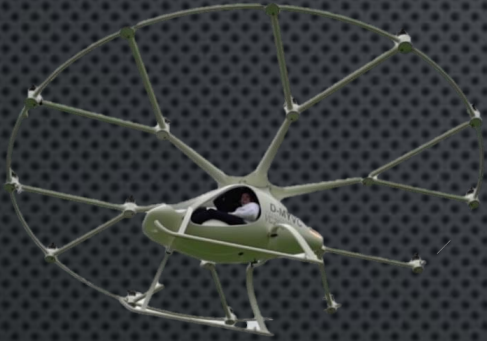
Eviation Alice



- No direct thrust control
- Gnd control on TKO and LND
- 9 pax / 240 kts / 540 NM range
- Regional air service – think Cape Air



# eVTOL





# JOBY AIR TAXI – JAN. 2020





# CITYAIRBUS – JAN. 2020





# WISK



FLYER



CORA



HEAVISIDE





# MULTI-ROTOR ROTORCRAFT



Alakai Skia



- Current FAA project
- Prototype flying in US

Volocopter



- Current EASA and FAA project
- Prototype flying in Dubai



# PIPISTREL



QUIET | SAFE | FAST

5 SEAT VTOL



PIPISTREL  
VERTICAL  
SOLUTIONS





# BELL NEXUS



- Bell and Safran share a vision for electric and hybrid-electric aircraft
- Affordable flight controls system that will serve future piloted and fully autonomous





# EMBRAERX





# PIASECKI PA-890 COMPOUND COMMERCIAL HELICOPTER



Piasecki Aircraft Corporation is investigating a more traditional rotorcraft configuration as its potential entry into the rapidly emerging eVTOL marketplace.

The PA-890 eVTOL aircraft is an all-electric-powered Slowed-Rotor Winged Compound helicopter. It is intended for use in a variety of missions including delivery of high-value On-Demand Logistics (ODL); On-Demand Mobility (ODM) personnel air transport; and Emergency Medical Services (EMS), as well as potentially aerial tourism and other commercial applications.



# VERTICAL AEROSPACE - UK



POC



Flew in 2018

Seraph



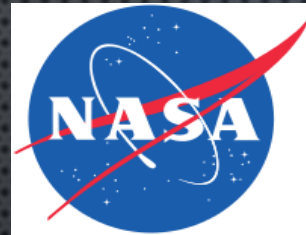
Flew in 2019



# EPIC 2015 - 11



K I T T Y H A W K

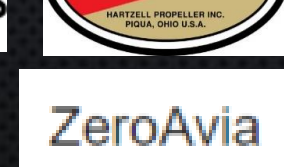
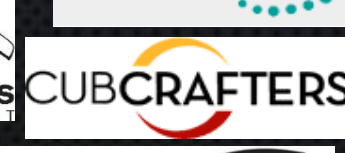
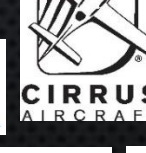
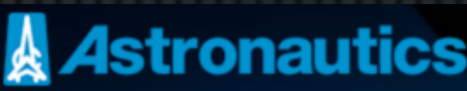
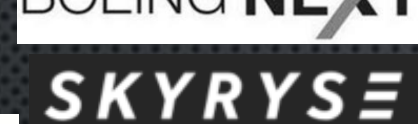




# EPIC 2020 - 83



AVIATION





# GAMA EPIC AND SUBCOMMITTEES



Electric Propulsion &  
Innovation Committee  
(EPIC)

Simplified Vehicle  
Operation Subcommittee  
(SVO)

Hybrid & Electric  
Propulsion Subcommittee  
(ELC)

eVTOL  
Subcommittee  
(eVTOL)

Infrastructure  
Subcommittee  
(INF)

DATA Communications  
Ad-Hoc Committee  
(DATA)

Flight Licensing &  
Certification Ad-Hoc  
Committee  
(FLC)

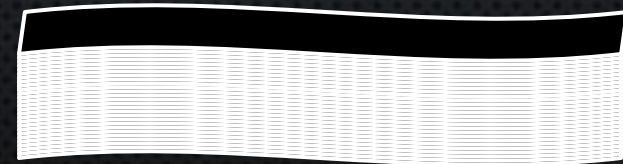
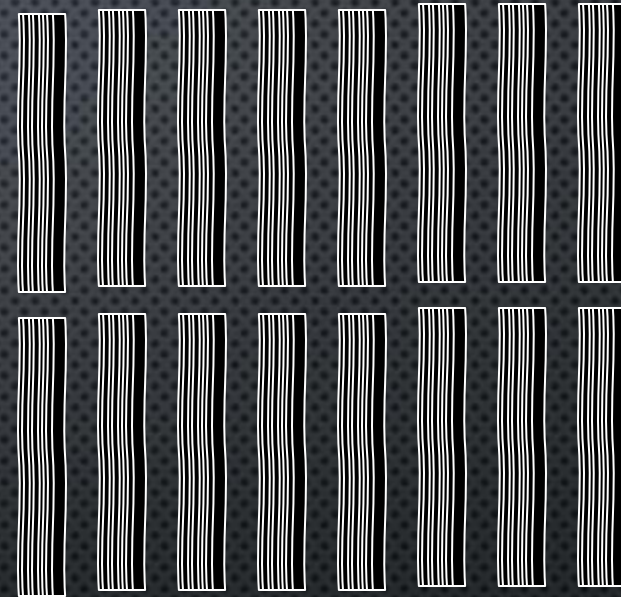


# PART/CS 23 – A BIG OPPORTUNITY



Part 23-63 (377 Regulations)

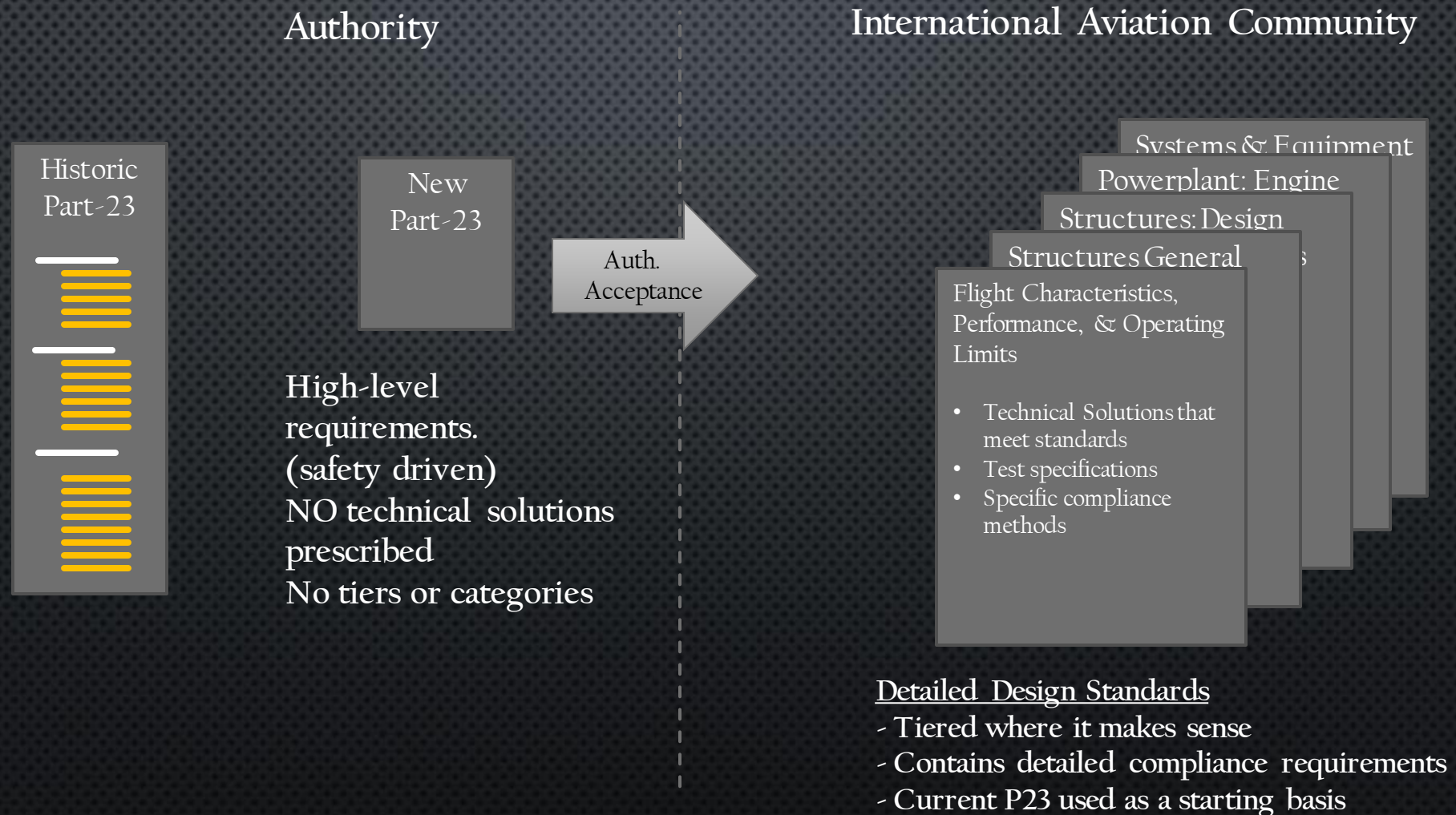
Consensus Stds.



Part 23-64 (71 Regulations)



# SEPARATING SAFETY REQUIREMENTS FROM METHODS OF COMPLIANCE





# ELECTRIC PROPULSION REGULATORY ENVIRONMENT: Q1-2016



	ANAC	CAAC	EASA	FAA	Transport Canada
Sport Aero					
Sm. Aero					
Lg. Aero					
Rotorcraft					
Engine					
Prop					



# ELECTRIC PROPULSION REGULATORY ENVIRONMENT: Q1-2017



	ANAC	CAAC	EASA	FAA	Transport Canada
Sport Aero	Yellow	Green	Green	Yellow/Red Diagonal	Yellow/Red Diagonal
Sm. Aero	Yellow/Red Diagonal	Yellow/Red Diagonal	Yellow/Red Diagonal	Yellow/Red Diagonal	Yellow/Red Diagonal
Lg. Aero	Red	Red	Red	Red	Red
Rotorcraft	Red	Red	Red	Red	Red
Engine	Red	Red	Yellow	Yellow	Red
Prop	Red	Red	Yellow	Yellow	Red



# ELECTRIC PROPULSION REGULATORY ENVIRONMENT: Q1-2018



	ANAC	CAAC	EASA	FAA	Transport Canada
Sport Aero	Yellow	Green	Green	Yellow/Red Diagonal	Yellow/Red Diagonal
Sm. Aero	Yellow/Red Diagonal	Yellow/Red Diagonal	Green	Green	Yellow/Red Diagonal
Lg. Aero	Red	Red	Yellow	Yellow	Red
Rotorcraft	Red	Red	Red	Red	Red
Engine	Red	Red	Yellow/Red Diagonal	Yellow/Red Diagonal	Red
Prop	Red	Red	Yellow/Red Diagonal	Yellow/Red Diagonal	Red



# ELECTRIC PROPULSION REGULATORY ENVIRONMENT

## Q1-2019 & Q1-2020



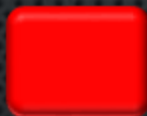
Sport Aero



Sm. Aero



Lg. Aero



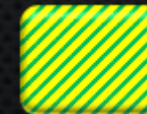
Rotorcraft



Engine



Prop.





**CNN BUSINESS**

**Uber and Hyundai team up to put flying taxis in the sky**

**Forbes**

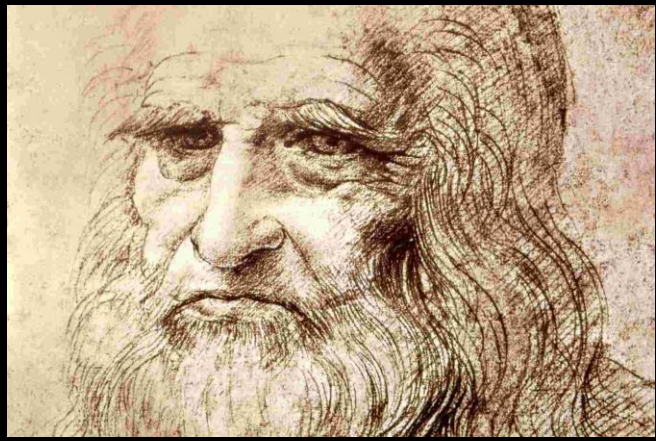
**Toyota Invests \$394 Million in  
Electric Air Taxi Company Joby  
Aviation**





## Six Urban Air Mobility Aircraft 'Well Along' in Type Certification, FAA's Merkle Says





FOR ONCE YOU HAVE TASTED FLIGHT YOU WILL WALK THE EARTH  
WITH YOUR EYES TURNED SKYWARDS, FOR THERE YOU HAVE BEEN  
AND THERE YOU WILL LONG TO RETURN.”

- LEONARDO DA VINCI -  
1452 - 1519

